What is claimed is:

1. A transmission characteristic equalizing system comprising:

at least one optical tunable filter having a variable transmission factor versus wavelength characteristic and placed along an optical transmission path between a transmitting station and a receiving station in a wavelength division multiplexing optical communication system;

a transmission characteristic measurement unit measuring transmission characteristics of optical signals of different wavelengths transmitted over the optical transmission path; and

a transmission characteristic control unit, on the basis of the measurements made by the transmission characteristic measurement unit, controlling amounts of pre-emphasis in the transmitting station and the transmission factor versus wavelength characteristic of the optical tunable filter to thereby equalize the transmission characteristics for the optical signals.

2. The system according to claim 1, wherein the transmission characteristic control unit calculates optimum allocation between a controlled variable of the amounts of pre-emphasis in the transmitting station and a controlled

amount of the transmission factor versus wavelength characteristic of the optical tunable filter and controls the amounts of pre-emphasis and the transmission factor versus wavelength characteristic according to the optimum allocation to thereby equalize and optimize the transmission characteristics.

3. The system according to claim 2, wherein the transmission characteristic control unit first controls only the transmission factor versus wavelength characteristic of the optical tunable filter to temporarily equalize the transmission characteristics for the optical signals, then calculates the optimum allocation with reference to the transmission factor versus wavelength characteristic of the optical tunable filter at the time of the temporal equalization of the transmission characteristics, and controls both the transmission factor versus wavelength characteristic of the optical tunable filter and the amounts of pre-emphasis in the transmitting station according to the optimum allocation of control to equalize and optimize the transmission characteristics.

4. The system according to claim 3, wherein the transmission characteristic measurement unit measures first and second transmission characteristic values having a

correlation with each other as the transmission characteristics, and the transmission characteristic control unit first controls only the transmission factor versus wavelength characteristic of the optical tunable filter to equalize the first transmission characteristic values and then temporarily equalize the second transmission characteristic values with reference to the equalized first transmission characteristic values, then calculates the optimum allocation with reference to the transmission factor versus wavelength characteristic of the optical tunable filter at the time of temporary equalization of the second transmission characteristic values, and controls both the transmission factor versus wavelength characteristic of the optical tunable filter and the amounts of pre-emphasis in the transmitting station according to the optimum allocation to thereby equalize the second transmission characteristic values.

5. The system according to claim 4, wherein the process of controlling only the transmission factor versus wavelength characteristic of the optical tunable filter to temporarily equalize the second transmission characteristic values is performed by reducing the transmission factor of the optical tunable filter for each wavelength to decrease the first transmission characteristic values and thereby lower the

second transmission characteristic values to a given target value, restoring the transmission factor of the optical tunable filter to its original value to restore the first transmission characteristic values to their initial values, determining the widths of variation of the first transmission characteristic values at that point, determining the average of the widths of variation of the first transmission characteristic values over all wavelengths, and adjusting the transmission factor of the optical tunable filter for each wavelength to vary each of the first transmission characteristic values by the difference between the average and the corresponding width of variation.

6. The system according to claim 4, wherein the process of calculating the optimum allocation is performed by, with the transmission factors of the optical tunable filter to which reference is made assumed as 100 %, controlling the amounts of pre-emphasis in the transmitting station to equalize the second transmission characteristic values each time the transmission factors of the filter are reduced by a percentage, calculating the average of the equalized second transmission characteristic values over all wavelengths each time the transmission factors of the filter are reduced by the percentage, and using the percentage of a reduction in the transmission factors when the average

is a maximum as the optimum allocation.

7. The system according to claim 6, wherein the process of controlling the amounts of pre-emphasis in the transmitting station to equalize the second transmission characteristic values is performed by controlling the amounts of pre-emphasis to equalize the first transmission characteristic values, adjusting the amounts of pre-emphasis for each wavelength to decrease the first transmission characteristic values and thereby temporarily lower the second transmission characteristic values to a given target value, restoring the amounts of pre-emphasis to their original values to restore the first transmission characteristic values to their initial values, determining the widths of variation of the first transmission characteristic values at that point, determining the average of the widths of variation of the first transmission characteristic values for all wavelengths, and adjusting the amount of pre-emphasis for each wavelength to vary each of the first transmission characteristic values by the difference between the average and the corresponding width of variation.

8. The system according to claim 4, wherein the transmission characteristic control unit calculates the

optimum allocation prior to start of the operation of the communication system and controls the amounts of pre-emphasis and the transmission factor versus wavelength characteristic according to the optimum allocation during the operation of the communication system to thereby equalize and optimize the transmission characteristics.

9. The system according to claim 8, wherein the process of controlling the amounts of pre-emphasis and the transmission factor versus wavelength characteristic according to the optimum allocation during the operation of the communication system is performed by adjusting the amount of pre-emphasis or the transmission factor for each wavelength to decrease the first transmission characteristic values and thereby temporarily lower the second transmission characteristic values to a given target value, restoring the amount of pre-emphasis or the transmission factor to their original values to restore the first transmission characteristic values to their initial values, determining the widths of variation of the first transmission characteristic values at that point, determining the average of the widths of variation of the first transmission characteristic values over all wavelengths, adjusting the transmission factor for each wavelength to vary the first transmission characteristic values by an amount

corresponding to the optimum allocation, and adjusting the amount of pre-emphasis for each wavelength to further vary the first transmission characteristic values by an amount corresponding to the optimum allocation.

10. The system according to claim 9, wherein, assuming the ratio representing the optimum allocation between a controlled variable of the transmission factor versus wavelength characteristic and a controlled variable of the amounts of pre-emphasis to be X to 1 - X, a variation in the first transmission characteristic values by control of the wavelength characteristic according to the optimum allocation is the product of the difference and X, and a variation in the first transmission characteristic values by control of the amounts of pre-emphasis according to the optimum allocation is the product of the difference and 1 - X.

11. The system according to claim 9, wherein the given target value is the minimum value of the second transmission characteristic values specified by the communication system.

12. The system according to claim 11, wherein the first transmission characteristic values are optical signal to noise ratios (OSNR), and the second transmission

characteristic values are Q factors.

13. The system according to claim 11, wherein the first transmission characteristic values are optical signal to noise ratios (OSNR), and the second transmission characteristic values are bit error rates (BER).

14. The system according to claim 1, wherein the transmission characteristic measurement unit is provided in the receiving station.

15. The system according to claim 1, wherein the transmission characteristic control unit is provided in the receiving station and the amounts of pre-emphasis in the transmitting station and the transmission factor versus wavelength characteristic of the optical tunable filter are controlled by the receiving station.

16. The system according to claim 1, wherein the transmission characteristic control unit is provided in the transmitting station and the amounts of pre-emphasis in the transmitting station and the transmission factor versus wavelength characteristic of the optical tunable filter are controlled by the transmitting station.

17. The system according to claim 1, wherein the amounts of pre-emphasis in the transmitting station are controlled via one of an overhead signal, a control signal superimposed on a main signal amplitude, and a dedicated control signal.

18. The system according to claim 1, wherein the transmission factor versus wavelength characteristic of the optical tunable filter is controlled via one of an overhead signal, a control signal superimposed on a main signal amplitude, and a dedicated control signal.

19. A method for equalizing transmission characteristics for optical signals comprising:

(a) placing at least one optical tunable filter having a variable transmission factor versus wavelength characteristic along an optical transmission path between a transmitting station and a receiving station in a wavelength division multiplexing optical communication system;

(b) measuring transmission characteristics of optical signals of different wavelengths transmitted over the optical transmission path; and

(c) controlling, on the basis of the measurements of the transmission characteristic, the amounts of pre-emphasis in the transmitting station and the transmission factor

versus wavelength characteristic of the optical tunable filter to thereby equalize the transmission characteristics for the optical signals.

20. The method according to claim 19, wherein, in step (c), optimum allocation between a controlled variable of the amounts of pre-emphasis in the transmitting station and a controlled amount of the transmission factor versus wavelength characteristic of the optical tunable filter is calculated and the amounts of pre-emphasis and the transmission factor versus wavelength characteristic are controlled according to the optimum allocation to thereby equalize and optimize the transmission characteristics.

21. The method according to claim 20, wherein, in step (c), only the transmission factor versus wavelength characteristic of the optical tunable filter is controlled to temporarily equalize the transmission characteristics for the optical signals, then the optimum allocation is calculated with reference to the transmission factor versus wavelength characteristic of the optical tunable filter at the time of temporary equalization of the transmission characteristics, and both the transmission factor versus wavelength characteristic of the optical tunable filter and the amounts of pre-emphasis in the transmitting station are

controlled according to the optimum allocation of control.

22. The method according to claim 21, wherein, in step (b), first and second transmission characteristic values having a correlation with each other are measured as the transmission characteristics, and, in step (c), only the transmission factor versus wavelength characteristic of the optical tunable filter is controlled to equalize the first transmission characteristic values and then temporarily equalize the second transmission characteristic values with reference to the equalized first transmission characteristic values, then the optimum allocation is calculated with reference to the transmission factor versus wavelength characteristic of the optical tunable filter at the time of temporary equalization of the second transmission characteristic values, and both the transmission factor versus wavelength characteristic of the optical tunable filter and the amounts of pre-emphasis in the transmitting station are controlled according to the optimum allocation to thereby equalize the second transmission characteristic values.

23. The method according to claim 22, wherein the process in step (c) of controlling only the transmission factor versus wavelength characteristic of the optical

tunable filter to temporarily equalize the second transmission characteristic values is performed by reducing the transmission factor of the optical tunable filter for each wavelength to decrease the first transmission characteristic values and thereby lower the second transmission characteristic values to a given target value, restoring the transmission factor of the optical tunable filter to its original value to restore the first transmission characteristic values to their initial values, determining the widths of variation of the first transmission characteristic values at that point, determining the average of the widths of variation of the first transmission characteristic values over all wavelengths, and adjusting the transmission factor of the optical tunable filter for each wavelength to vary each of the first transmission characteristic values by the difference between the average and the corresponding width of variation.

24. The method according to claim 22, wherein the process in step (c) of calculating the optimum allocation is performed by, with the transmission factors of the optical tunable filter to which reference is made assumed as 100 %, controlling the amounts of pre-emphasis in the transmitting station to equalize the second transmission characteristic values each time the transmission factors of the filter are

reduced by a percentage, calculating the average of the equalized second transmission characteristic values over all wavelengths each time the transmission factors of the filter are reduced by the percentage, and using the percentage of a reduction in the transmission factors when the average is a maximum as the optimum allocation.

25. The method according to claim 22, wherein the process in step (c) of controlling the amounts of pre-emphasis in the transmitting station to equalize the second transmission characteristic values is performed by controlling the amounts of pre-emphasis to equalize the first transmission characteristic values, adjusting the amounts of pre-emphasis for each wavelength to decrease the first transmission characteristic values and thereby temporarily lower the second transmission characteristic values to a given target value, restoring the amounts of pre-emphasis to their original values to restore the first transmission characteristic values to their initial values, determining the widths of variation of the first transmission characteristic values at that point, determining the average of the widths of variation of the first transmission characteristic values for all wavelengths, and adjusting the amount of pre-emphasis for each wavelength to vary each of the first transmission characteristic values by the

difference between the average and the corresponding width of variation.

26. The method according to claim 22, wherein, in step (c), the optimum allocation is calculated prior to the start of the operation of the communication system and the amounts of pre-emphasis and the transmission factor versus wavelength characteristic are controlled according to the optimum allocation during the operation of the communication system to thereby equalize and optimize the transmission characteristics.

27. The method according to claim 26, wherein the process in step (c) of controlling the amounts of pre-emphasis and the transmission factor versus wavelength characteristic according to the optimum allocation during the operation of the communication system is performed by adjusting the amount of pre-emphasis or the transmission factor for each wavelength to decrease the first transmission characteristic values and thereby temporarily lower the second transmission characteristic values to a given target value, restoring the amount of pre-emphasis or the transmission factor to their original values to restore the first transmission characteristic values to their initial values, determining the widths of variation of the first transmission

characteristic values at that point, determining the average of the widths of variation of the first transmission characteristic values over all wavelengths, adjusting the transmission factor for each wavelength to vary the first transmission characteristic values by an amount corresponding to the optimum allocation, and adjusting the amount of pre-emphasis for each wavelength to further vary the first transmission characteristic values by an amount corresponding to the optimum allocation.

28. The method according to claim 27, wherein, assuming the ratio representing the optimum allocation between a controlled variable of the transmission factor versus wavelength characteristic and a controlled variable of the amounts of pre-emphasis to be X to 1 - X, a variation in the first transmission characteristic values by control of the wavelength characteristic according to the optimum allocation is the product of the difference and X, and a variation in the first transmission characteristic values by control of the amounts of pre-emphasis according to the optimum allocation is the product of the difference and 1 - X.

29. The method according to claim 27, wherein the given target value is the minimum value of the second transmission

characteristic values specified by the communication system.

30. The method according to claim 22, wherein the first transmission characteristic values are optical signal to noise ratios (OSNR), and the second transmission characteristic values are Q factors.

31. The method according to claim 22, wherein the first transmission characteristic values are optical signal to noise ratios (OSNR), and the second transmission characteristic values are bit error rates (BER).

32. The method according to claim 19, wherein the measurements in step (b) are made by the receiving station.

33. The method according to claim 19, wherein control in step (c) of the amounts of pre-emphasis in the transmitting station and the transmission factor versus wavelength characteristic of the optical tunable filter is performed by the receiving station.

34. The method according to claim 19, wherein control in step (c) of the amounts of pre-emphasis in the transmitting station and the transmission factor versus wavelength characteristic of the optical tunable filter is performed

by the transmitting station.

35. A optical tunable filter placed along an optical transmission path between a transmitting station and a receiving station in a wavelength division multiplexing optical communication system, wherein transmission factor versus wavelength characteristic of the variable optical filter is controlled when the transmission characteristics for optical signals of different wavelengths propagated over the optical transmission factors are measured and the amounts of pre-emphasis in the transmitting station are controlled based on the measurements of the transmission characteristics so as to equalize the transmission characteristics.

36. A receiving station used in a wavelength division multiplexing optical communication system in which at least one optical tunable filter having a controllable transmission factor versus wavelength characteristic is placed along an optical transmission path between a transmitting station and the receiving station, the receiving station including:

a transmission characteristic measurement unit measuring transmission characteristics of optical signals of different wavelengths transmitted over the optical transmission path; and

a transmission characteristic control unit, on the

basis of the measurements by the transmission characteristic measurement unit, controlling the amounts of pre-emphasis in the transmitting station and the transmission factor versus wavelength characteristic of the optical tunable filter to thereby equalize the transmission characteristics for the optical signals.

37. A transmitting station used in a wavelength division multiplexing optical communication system in which at least one optical tunable filter having a controllable transmission factor versus wavelength characteristic is placed along an optical transmission path between the transmitting station and a receiving station, the transmitting station including:

a transmission characteristic control unit controlling, when transmission characteristics of optical signals of different wavelengths transmitted over the optical transmission path are measured, amounts of pre-emphasis in the transmitting station and the transmission factor versus wavelength characteristic of the optical tunable filter on the basis of the measured transmission characteristics to thereby equalize the transmission characteristics for the optical signals.